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From Babak Vosooghzadeh [mailto bobvos@metacrawler.com]
Sent: Sunday, January 04, 2004 2:11 PM
To: Mike Marcus
Subject: Millimeter wave Wireless Broadband Systems (WT Doc. No. 02-146)

Dear Mr Marcus

SUBJECT: A request for the "Feasibility study on the Millimeter wave Wireless Broadband Systems which utilize the 1st Generation of Signal Recovery (Ultra Low Power Processing) Modules."

[Ultra Low Power microwave signals operate at (or below) the noise level of the un-processed receiver]

Low power millimeter wave Personal Communication with miniature or integrated antennas for hand set wireless devices is becoming a reality

The demand for higher wireless data rate throughput and the spectrum crowding of the lower microwave frequencies has forced the communications community to examine the rich available spectral bandwidth of the millimeter wave region.

However, due to the channel propagation factors of the millimeter wave region, the smaller effective aperture of the antenna and the power restrictions for unlicensed operation, current high throughput operations can only be achieved at small distances between the devices.

Fortunately, the SIGNAL RECOVERY MODULES resolve the above mentioned millimeter wave broadband issues by recovering Ultra Low Power r.f. signals (See the topic on "THE SIGNAL RECOVERY MODULES")

The range of applications for Signal Recovery Modules include:

1- Millimeter wave wireless terrestrial and satellite solutions for long distance high data rate applications and ultra low r.f. power processing

For example, a wireless user should have the ability to perform simultaneous video conferencing with 20 groups
along with access to diversified critical services and/or remote access to (buildings, physical & geographical sites
via wireless cameras). See the "Concluding Remarks".

2- Antenna type management for different millimeter wave wireless devices
For HANDSET wireless devices, miniature or integrated antennas can be used Larger antennas will be used for FIXED wireless devices such as terrestrial base stations, and portable or compact size antennas can be used for millimeter wave mini-cell stations and indoor applications

2- The use of Signal Recovery modules on Ultra Wideband (UWB) and

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----------THE ADVISORY COMMITTEES

There will be two Advisory Committees in relation to the Signal Recovery Modules

[The Advisory Committee for Defining the Signal Recovery Modules] will most likely perform the following tasks:

-Feasibility study on the current limits of Signal Recovery Modules

-The terminology for the Signal Recovery Modules. Note that the Committee might even change the generic name of "Signal Recovery" to "Advanced Communication Channel Processing".

-Evaluate the Candidate Standards on Signal Recovery Modules as offered by the participating Research Institutions and Communication companies at a later stage.

Note: The final work on this Committee will be used in the manufacturer's specification For example, a description might look like " In the channel mode xx, the wireless set provides Doppler compensation of type xx, fading compensator of type xx, receiver noise suppressor of type xx, ".

[The advisory Committee for Wireless Access Protocols and Spectrum Management of the Wideband Systems using the Signal Recovery Modules] will most likely perform the following tasks:

-Feasibility study on the openness of the Channel Access Protocols

-Evaluation of the Candidate Standards on the Channel Access Protocols for different frequency bands as offered by the participating Research Institutions and Communication companies.

Note The products that only concentrate on the (low power r f. reception) aspect of the Signal Recovery modules will probably hit the market within 2 years after the formation of the 1st Committee. These products include Satellite Receivers, Cell phones and Satmobiles with the ultra low r.f power receiver option, unlicensed UWB devices for long distance operations , certain measuring and medical instruments, and remote sensing devices

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other unlicensed devices for eliminating spectral interference with the licensed operators. (See the topic on "New guidelines for sharing the available spectrum and the reduction of man-made radio noise")

3- Redundant and Diversified Homeland Security solutions.
For example, overlapping Ground and Satellite microwave relays can be used and upon the detection of certain abnormal ground conditions, balloon supported battery-backed suspending transceivers can be ejected or commissioned from selected areas to compensate for the loss of ground relays. These transceivers have remote sensing features for activating the mechanical gliding system in case of balloon leakage for fail-safe landing on a comfortable ground spot in order to prolong their critical operations.

4- Remote Sensing

Within a short period of time, Communications Companies & Research institutions will provide their concepts and ideas regarding the Signal Recovery Modules for FCC review.

These concepts will lay the foundation for the Feasibility study on "The Millimeter wave Wireless Broadband Systems that use the 1st Generation of Signal Recovery Modules" which will most likely be conducted by the Office of Engineering & Technology.

At a later stage, the Advisory Committees would most likely become active. (See the topic on "THE ADVISORY COMMITTEES").

CONCLUDING REMARKS:

The Signal Recovery Modules provide the means for accessing the rich available spectral bandwidth of the millimeter wave region. By incorporating these modules in wireless devices, consumers are able to use a variety of wireless services including teleconferencing, access to critical services, remote access to (buildings, physical & geographical sites via wireless cameras), multimedia processing, and remote management & control.

These modules have a great impact on the market for wireless devices which includes terrestrial and satellite Mobile handsets & portable sets, fixed receivers like satellite receivers, terrestrial base stations, millimeter wave mini-cell stations for metropolitan & dense area wireless processing, wireless cameras and satellites.

I hope that the future reports provided by the Communications industry would provide a firm evidence for their willingness to pursue this technology trend and I hope that with your evaluation, we could embark on a new age of Millimeter Wave Personal Communication

Best Regards,

from the channel decoder Forward Error Correction decision circuitry

Note that during the initial signal acquisition, the channel decoder is dependant on the Signal Recovery Modules for providing partial correct data. Once the channel decoder becomes active, the Signal Recovery Modules including the Receiver Noise Suppressor use the intelligence from the channel decoder to update their Signal Processing parameters

Note that enhanced Channel Coding schemes are critical for the operation of Signal Recovery Modules at the millimeter wave spectral region Fortunately, the higher bandwidth of the millimeter wave region allows easier Channel Coding schemes without sacrificing any noticeable data rate throughput.

-"NEW GUIDELINES FOR SHARING THE AVAILABLE SPECTRUM AND THE REDUCTION OF MAN-MADE RADIO NOISE"

The r f. interference caused by different wireless systems might be detrimental to the operation of critical wireless services. Therefore, new wireless devices should incorporate hardware features to eliminate r f. spectral interference

The following guidelines for sharing the available spectrum could serve as a mean for eliminating the interference.

1-For every frequency range, the wireless systems should be divided into privilege and slave systems. For example, licensed operators are privileged users of the r f channel, where as unlicensed UWB (Ultra Wide Band) users are frequency slaves.

2-Privilege users should specify their minimum required spectral power density for the safe and critical operation of their wireless system. The slave users of the relevant frequency range should always operate below the minimum power level of the privileged users of the same frequency range during simultaneous operations.

3-The slave users of the relevant frequency range should eliminate interference by either changing their operating frequency band or lowering their transmitted power. When all options for frequency assignment and power management are exhausted, the slave users should abort the transmission rather than share the spectrum with the privileged users.

4- Interference test certificates should be provided by the manufacturers of NEW frequency slave devices.

5-New wireless systems should exploit higher microwave frequency range where there are fewer traditional users.

6-It is recommended that NEW privileged devices incorporate interference detection circuitry as a safeguard for fault operation of the slave users.

Babak Vosooghzadeh

----------THE SIGNAL RECOVERY MODULES

In the millimeter wave region alike lower frequency range, the microwave signal is subject to adverse communication channel propagation factors such as noise from the transmitter, path loss (signal attenuation), channel interference noise, multi-path fading, Doppler Frequency Shift (for fast moving transceivers) and the receiver noise.

As you are well aware, the path loss (signal attenuation) is lower in the low microwave frequency region relative to the high frequency (millimeter wave) region due to the higher effective aperture of the antenna. Therefore, by using the proper channel coding & modulation schemes at the transmitter and proper demodulation & channel decoding at the receiver, the lower frequency microwave receiver can readily combat the communication channel effects and recover the signal

However, in the millimeter wave region, the signal level becomes very low at long distances between the transmitter and the receiver. As you are well aware, for low power transmission, the signal power at the receiver reaches Ultra low power levels. At these levels, the signal power is comparable to the noise level of the un-processed receiver analog circuitry and the receiver cannot take advantage of the channel coding and it cannot perform any useful function unless the RECEIVER NOISE is SUPPRESSED.

In order to take advantage of the rich available spectral bandwidth of the millimeter wave region, the following Signal Recovery Modules should be used·

1- The [RECEIVER NOISE SUPPRESSOR] as a Signal Recovery Module uses special cascaded low gain LNAs (Low Noise Amplifiers) with adjustable gain setting, special analog adaptive filters (or General ASP), high gain INAs, special demodulator circuitry, special A/D's and adaptive Inverse Digital Filters (or General DSP) to suppress the receiver noise and compensate for the signal attenuation.

The initial adaptive filter (or General DSP) parameters, the analog adaptive filters (or General ASP) and amplifier gain settings are usually trained (derived) during the manufacturing hardware testing phase of the particular wireless receiver by comparing a healthy test data set with the digitized version of the demodulated Ultra low power signal.

2- The Fading Compensator, Doppler Compensator(if required), Non- receiver Noise Suppressor and other Signal Recovery Modules
basically model the whole Communication Channel (or perform channel partial Inverse Operations) by the knowledge of signature waveforms, the statistics of the channel along with the critical assistance